

Designing Knowledge Management Systems for Teaching and Learning with Wiki Technology

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ABSTRACT

A wiki is a group collaboration software tool based on Web server technology. This paper examines the use of a wiki to facilitate knowledge management in an academic setting. We present a case study about how a wiki was used to support collaborative activities in a knowledge management class at a graduate-level information systems and technology school. Our findings suggest that wikis can support collaborative knowledge creation and sharing in an academic environment. Success in attempts to provide such support may depend on: familiarity with wiki technology, careful planning for implementation and use, appropriate class size, and motivation of students to engage in discovery learning.

Keywords: Wiki technology, Knowledge Management, Teaching and Learning, Systems Design

1. MOTIVATION

The majority of literature pertaining to implementation of knowledge management systems emphasizes the corporate world (see Von Krogh 1998; Hackbarth 1998; Davenport and Prusak 1998; Alavi and Leidner 2001). If one is interested in educational settings, one is left with some important questions: How relevant are knowledge management systems to education? Can knowledge management systems be designed to support teaching and learning objectives? What should a knowledge management system for teaching and learning include? What do emerging social software technologies, such as wikis, have to offer in the design of knowledge management systems for teaching and learning?

With or without answers to such questions, academics—teachers and researchers alike—can be expected to create software artifacts to support knowledge management for teaching and learning. This paper explores how best to create such artifacts. To that end, it reports our experiences in using a social software tool (namely, wiki technology) to support academic knowledge management. Through these experiences, we have learned what needs to be done next in order to learn more.

Our school offers a knowledge management course, which has as one of its objectives to expose students to knowledge management technology. In this course, we introduce wiki technology as a simple and inexpensive, but practical, tool that has value for knowledge management. Details about wikis and the objectives of our knowledge management course are discussed below.

The objectives of this paper are to examine: (i) what attributes a knowledge management system for teaching and learning should have, (ii) if wikis can be used to implement a knowledge management system for teaching and learning, and (iii) if wiki technology is effective in its support for knowledge creation and sharing in an academic setting. Note that the case study reported here was not conducted as a formal design science project, but as an attempt to have the students actively learn about wiki technology and how this technology might serve as a knowledge management system for teaching and learning.

The paper proceeds as follows. Section two provides an overview of wiki technology. Section three examines why wiki technology could be used in the design of a knowledge management system for teaching and learning, based on the Alavi and Leidner (2001) knowledge management framework. Section four presents a case study, which involved the design of a wiki as an instantiation of a knowledge management system to support teaching and learning in a graduate-level knowledge management class.

2. OVERVIEW OF WIKI TECHNOLOGY

'Wiki' is the Hawaiian word for 'quick'. Leuf and Cunningham (2001) define a wiki as "a freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information—a database where each page is easily editable by any user with a forms-capable Web browser client" (p.14).

Leuf and Cunningham offer several *technical* attributes of wiki technology:

- Wikis run over the World Wide Web and can be supported by any browser.
- The technology is governed by an underlying HTTP protocol that determines client and server communication.
- Wikis are able to respond to both requests for data (GET) and data submission (POST), in a given Web front, based on the HTTP protocol.

From a *functional* dimension, they discuss three major attributes of wiki technology:

- Any member of a wiki community can edit any pages in that community's wiki Web site. The editing of wiki pages does not require any additional functions in the Web browser.
- Members of a wiki community can build and develop "meaningful topic associations" (p.16) by creating numerous links between wiki pages. The linking of wiki pages is simple to do.
- Originally the technology was not meant to engage casual visitors; rather, the technology was designed to enable users to regularly update the wiki pages in a collaborative fashion, thereby continuously changing the nature of the wiki Web site.

Wikis are increasingly being accepted as a new breed of collaborative technology. Wiki technology can impact knowledge management, and can support knowledge

creation and sharing (Leuf and Cunningham 2001; Wagner 2004; Lamb 2004). The first wiki, implemented in 1995 by the Portland Pattern Repository group, permitted users to create, edit, and organize content in a Web format (Wagner 2004). Wagner describes eleven principles that govern the design of a wiki. These principles are summarized in Table 1.

Principle	Explanation
Open	If a page is found to be incomplete or poorly organized, any reader can edit it as he/she sees fit. Wiki is based on open-source technology.
Incremental	Pages can cite other pages, including pages that have not been written yet.
Organic	The structure and text content of the site is open to editing and evolution.
Mundane	A small number of (irregular) text conventions will provide access to the most useful (but limited) page markup.
Universal	The mechanisms of editing and organizing are the same as those of writing so that any writer is automatically an editor and organizer.
Overt	The formatted (and printed) output will suggest the input required to reproduce it. (For example, location of the page.)
Unified	Page names will be drawn from a flat space so that no additional context is required to interpret them.
Precise	Pages will be titled with sufficient precision to avoid most name clashes, typically by forming noun phrases.
Tolerant	Interpretable (even if undesirable) behavior is preferred to error messages.
Observable	Activity within the site can be watched and reviewed by any other visitor to the site. Wiki pages are developed based on trust.
Convergent	Duplication can be discouraged or removed by finding and citing similar or related content.

Table 1. Wiki Design Principles
Wagner (2004, p. 270)

Wiki technology can address knowledge management goals for teaching and learning. The nature of wikis promotes several aspects of knowledge management for teaching and learning. These include the capability of most wiki tools to support:

- Group creation and revision of web pages;
- Storage and retrieval of related documents, images, and presentations;
- Searching of these;
- Management of changes to them; and
- Online discussions.

While only the first of these capabilities is necessarily part of a wiki, the technology can be configured to support many different features (Leuf and Cunningham 2001). The class in

our case used an instantiation of wiki technology called TikiWiki. TikiWiki is one of hundreds of wiki technology implementations. It was chosen because it is an open-source implementation with many additional features to complement the wiki itself.

Fuchs-Kittowsk and Köhler (2002) define a wiki as an “open author system for a conjoined construction and maintenance of Websites” (p.10). They suggest that wiki technology can provide the IT support needed to facilitate cooperative work and knowledge generation. Specifically, Fuchs-Kittowsk and Köhler suggest that a wiki might be applicable in “different scenarios: as content management system, discussion board or other forms of groupware” (p.10). Overall, they imply that a wiki can support the requirements for collaborative knowledge creation within both the corporate and academic environment. This would include using wikis to support teaching and learning activities.

Members of a wiki community can actively be involved in updating and editing the same document continuously. Leuf and Cunningham (2001) suggest that wikis can support continuous discussion during the process of creating and sharing knowledge. They also suggest that wiki technology can complement the delivery of class curriculum and projects.

3. VALUE OF WIKIS IN THE DESIGN OF KNOWLEDGE MANAGEMENT SYSTEMS FOR TEACHING AND LEARNING

Alavi and Leidner (2001) describe knowledge from six different perspectives. These perspectives can be considered when one is thinking about design requirements for knowledge management systems to support teaching and learning. We extended five of the six perspectives of knowledge inherent in the Alavi and Leidner framework to wiki technology in the context of teaching and learning as described in Table 2.

We do not argue that wiki technology is the only technology that can be used to support knowledge management activities in academia. Wagner (2004) describes nine conversational technologies that can be used to manage knowledge in corporations. These technologies are: “e-mail, static and database backed Web pages, discussion forums, internet chat, video-audio streaming, video-audio conference, GDSS, Web log and Wikis” (Wagner 2004 pp. 269). These technologies can be applied to the education process as well (see: Alavi 1994, Huang et al. 2002).

However, we feel that the following reasons support the use of wiki technology for teaching and learning objectives, in addition to how it might support knowledge management requirements for teaching and learning as summarized in Table 2.

- Wiki technology is an open-source technology and is downloadable at no cost.
- Wiki technology is easy to learn and understand. Once a wiki is installed, anyone can very quickly understand how to use key features within the technology.

- Wiki technology permits asynchronous discussion in that it enables students and instructors to engage in continuous discussion, when they have the time. This permits ability to share and update the knowledge base (Bergin 2002).
- Once a wiki page is created, it persists and can be updated. Wiki technology can be used as a knowledge repository.
- Wiki technology supports many-to-many communication and enables creation of new knowledge based on a given knowledge history (Wagner 2004).
- Instructors can use wiki technology as a knowledge base to keep track of student papers, presentations and projects. These can be viewed and updated using simple edit and link functions.

4. WIKI TECHNOLOGY IMPLEMENTATION: A CASE STUDY

A study was conducted in a knowledge management class at a graduate-level information systems and technology school in the US to demonstrate that wiki technology could support knowledge creation and sharing. This study was aimed at examining the notion that wiki technology can be an effective component in design of knowledge management systems for teaching and learning.

4.1 The Participants

Twenty students (three females and seventeen males, all majors in either information science or management) met in class for three hours per week over a sixteen-week period. This was the first attempt for the majority of the students to use wiki technology.

4.2 Objectives of Using a Wiki

The course was designed to focus on concepts and issues in knowledge management and how information systems are used for knowledge management. The goal was to enable students to learn about managing the design, development and operation of information technologies for knowledge management. During the semester, students were expected to create, refine, and maintain a knowledge management system, using an instantiation of wiki technology called TikiWiki. Students were assigned one or more roles for this process.

The knowledge management system was to be used to support the use (by students) of knowledge from different sources, including the course textbook, articles, cases, lectures, and the students' experiences in developing the system. Students were graded, in part, on the perceived quality and usefulness of their contributions, based on peer and instructor assessments. Details about grading are described in Section 4.3 below.

The instructor had four reasons for choosing wiki technology in this class:

- Wiki technology is easy to install (and free).
- Wiki technology provides capability for easy access and editing.

Perspective of Knowledge	Design requirements for knowledge management systems for teaching and learning	How wiki technology supports these requirements
Knowledge as a state of mind	<p>Knowledge management systems should assist students in assimilating the information presented in class.</p> <p>Knowledge management systems should enable students and instructors to share their experiences beyond regular classroom sessions.</p> <p>Knowledge management systems should enable students and instructors to know where knowledge is located.</p> <p>Knowledge management systems should permit Web and wireless access to knowledge bases.</p>	<p>Wikis use server-based technology. Once wiki pages are created by students and instructors, they persist. This could enhance students' ability to assimilate information in class, anytime they wish, and from anywhere they want to do so.</p> <p>Wiki design principles include being open, universal and incremental. Students and instructors can document and share their experiences continuously.</p> <p>Wiki technology is Web-based. It permits both wireless and wired access to knowledge bases.</p>
Knowledge as an object	<p>Knowledge management systems should permit students to gather, store, update, discuss and disseminate knowledge.</p>	<p>Students and instructors can create and edit pages to share experiences and discuss issues that relate to a particular topic discussed in class.</p> <p>Wiki pages are created based on a simple markup language.</p> <p>Pages can cite other pages based on a powerful back link function.</p> <p>The open nature of wikis enables anyone to create and update pages.</p> <p>Other features of a wiki can include blogs, FAQ, surveys, trackers, and forums that can be used to generate and share knowledge in a classroom environment.</p>
Knowledge as a process	<p>Knowledge management systems should provide students with links to various internal and external knowledge sources. This would include the use of Web-based systems, hyperlinks, markup languages, and access to databases. Knowledge management systems should offer students breadth and depth of knowledge flows that extend beyond textbooks and class notes.</p>	<p>Wiki pages can be linked to other pages through use of back links. Wikis can also be used to manage text and image documents.</p> <p>Wiki pages can be linked to external information sources. This would include links to other Web sites relevant to a particular topic.</p>
Knowledge and accessibility to information	<p>Knowledge management systems should allow students to access information quickly. Knowledge management systems should provide students with index, query and search functions to locate relevant information.</p>	<p>Indexing and quick links can be designed in a wiki to enable quick information retrieval. Wiki technology enables cascading style sheets and indexing capability.</p>
Knowledge as a capability	<p>Knowledge management systems should increase students' intellectual capital through individual and group competencies.</p>	<p>A wiki can offer students and instructors a Web-enabled knowledge base that encompasses class notes, presentations, and asynchronous discussion (after class hours).</p> <p>Wiki features can be configured to increase intellectual capital through collaborative student efforts.</p>

Table 2: Wiki Support for Design Requirements for Knowledge Management Systems for Teaching and Learning
Adapted from Alavi and Leidner (2001, p. 111)

- allows a class to develop a knowledge base readily.
- Wiki technology can aid knowledge creation and sharing in both corporate and academic settings.

The instructor was also seeking an environment where the work from the previous year's class could be updated by, and shared with, the current year's class. The instructor introduced the concept of wiki technology in the first class, explicitly stating the objectives of using the technology as part of the course. He explained the expectations and goals for using this technology. Specific plans for the development of the system were left to the students. One belief promoted by the instructor was that the more collaborative and active they were in using the technology, the better the quality of the final product would be. The instructor placed questions, comments and assignments on the wiki on a regular basis.

The instructor stressed that the class would be conducted based on collaborative efforts among students and the instructor. The class was designed based on the principles of discovery learning (Pieters et al. 2004). Students were given the opportunity to learn from one another and to use the instructor as a resource for creating, refining and maintaining their knowledge management system.

4.3 Wiki Settings

The design of the system was not guided by any particular theory. The technology was configured to allow students to perform the following functions:

- Link pages automatically.
- Create new pages from a main or source page.
- Perform markup functions such as text editing.
- Participate in online forums and quizzes designed by other students.
- Find specific pages or content by using the search function.
- Create blogs –personal Web pages used to express anything related to class content or discussion.

The wiki home page had various elements such as links to new concepts, news and class updates. One segment developed by the class was called the 'Article Review' where students were encouraged to summarize a total of 160 articles on knowledge management based on a predefined format. This was done in teams and anyone could review and make changes to any article reviewed.

4.4 Grading Scheme

The course grade was based on performance in three formal assignments: knowledge management system project (40%), knowledge base contribution (40%) and class participation (20%). Everyone in the class received forty points for the system project. The maintenance of most sections of the TikiWiki implementation was not complicated and the assignment of students to each part was somewhat arbitrary. Given that this was a very difficult assignment to calibrate, the instructor decided that giving everyone the same number of points (the maximum) was the only fair way to grade this component of the class.

The statistics he used to calculate the forty (knowledge contribution) points were (1) Total: The number of creations

and updates of wiki pages; (2) Unique: The number of different pages created and/or updated; (3) Article Review: The number of article review pages created and/or updated; and (4) Time: An estimate of the total time spent updating pages. The first three measures were directly derived from counts of a database of wiki page activity for the semester.

The fourth measure, Time, was also derived from this database, but it was an estimate. However, the instructor believed that it to be a relatively valid estimate. To make this estimate, he first calculated an elapsed time estimate for each session. A session was defined as a continuous set of page creation and/or update database entries where the previous entry was made less than one hour before the current entry. He summed all of these times to calculate the total time. Next, he weighted each of the four measures as follows: (1) Total – 35%; (2) Unique – 10%; (3) Article Review – 15%; and (4) Time – 40%. These weights were estimated based on correlations among the various measures as well as his best guess of how well each of the measures would mirror knowledge base creation activities. Since the instructor stressed time of usage, he made this the most important factor. The instructor realized that there may be discrepancies in these estimates, which also led him to give each student 40 points out of 40 for the knowledge management system project score.

He calculated a wiki activity score by taking the difference between each student's score on each of the four measures and the mean score of each measure, dividing it by the standard deviation of its measure, multiplying it by its weight and summing the four values. Then, he ranked these calculated scores and gave 30 points to the highest score. He reduced the next highest score by a factor based on the number of standard deviations that that score was from the highest score with each standard deviation being equivalent to 3 points. Thus if the highest activity score was 4 and the standard deviation 1, the student with the highest score received 30 points and a student with an activity score of 3 (that is, one standard deviation below the highest) received 27 points.

4.5 DATA COLLECTION

In phase two of the study, fifteen interviews were conducted with the students. These interviews were conducted using both face-to-face and e-mail exchanges over a one-month period after the knowledge management class had ended. During this phase, the respondents were asked several questions to obtain an in-depth view about their experiences in using the wiki. The questions were geared towards obtaining a better understanding of the students' perception of the following:

- Why the instructor used a wiki technology as part of the curriculum.
- Whether the objectives of using wiki technology were clearly communicated.
- Whether the process of using the wiki technology was clearly communicated.

- Whether wiki technology can support the goals of knowledge creation through collaborative efforts and discovery learning.

The interview sessions ranged between 45 minutes to one hour. Responses from these sessions were transcribed and coded using an open coding technique (Neuman 2003).

4.6 Survey Results

Five students had prior experience in using knowledge management tools. The most popular tool for facilitating knowledge sharing was chat (seven students), followed by e-mail (two students) and videoconference (two students). All the students claimed that they had no prior experience in using wiki technology to facilitate knowledge creation and sharing.

Seven students used the technology on a regular basis - more than 5 hours a week; ten students used the wiki often - (3-5 hours a week) and three used it occasionally only (1-2 hours a week). The regular users said that the main reason for using the wiki technology was to follow up with content covered in class. Only two students indicated that they had used the technology to facilitate team discussions. In this context, it can be argued that the technology was used mostly as a forum to create and extract knowledge pertaining to the knowledge management class, with limited focus on using it as a tool to facilitate collaborative knowledge creation and sharing.

Students were also asked to specify alternative methods of communication that should be employed to create and share knowledge. Fourteen students said that this could be facilitated by e-mail. Six students preferred face-to-face contact and discussions for the purpose of creating and sharing knowledge.

In addressing the question "which aspect of the wiki do you use the most?" two students claimed they had used the forum the most, and two students indicated they had used the FAQ the most. The most popular segments of the wiki technology were the wiki home page and the article review segment. The wiki home page generated the most use in terms of updates, posting and comments. This page received a total of 5285 hits, although only a total of 449 (8.5%) modifications were made. The second most popular feature was the article review page. This page generated a total of 2054 hits, but only 400 hits (20%) were updates or modifications to content. The top six participants in the class contributed 75% of the updates made on the home page. This is an indication that the wiki was used more to obtain information and update content than to build knowledge by virtue of collaborative effort.

Figure 1 summarizes wiki activity during the semester. The graph captures three core activities that can be performed by the wiki users: create new pages, update pages or rollback pages. Figure 1 suggests that the main activity done on the wiki was updating pages already in existence. These were summaries of journal articles developed by the previous years' students that had been uploaded to the wiki. While

these updates could be considered to constitute the addition or revision of knowledge, for the most part the technology was not used to generate new knowledge.

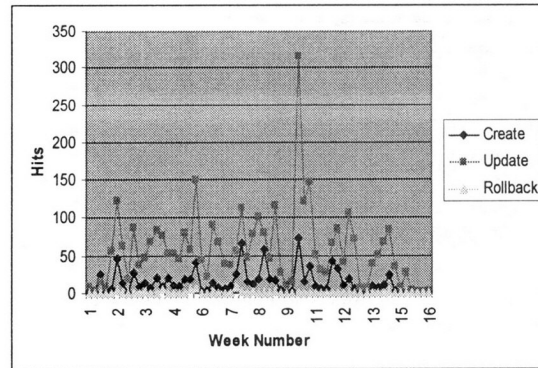


Figure 1. Weekly Activity Summary on the Wiki Over One Semester

The sudden spike in the graph occurs after the middle of the semester. This probably was due to a stern reminder by the instructor that a portion of the final grade for the class would be based on contribution and how frequently the students used the technology. The graph suggests that this reminder was only effective temporarily, as the level of activity declined significantly towards the end of the semester. In summary, findings from the survey suggest that the wiki technology was useful to manage and update existing knowledge, such as article summaries from a prior class. However, the technology was not effective in fostering collaborative creation of new knowledge.

4.7 Interview Results

The students were asked what they perceived the instructor's objectives to have been in using the wiki. The majority claimed that the instructor's prime motivation had been to enable students to gain familiarity in using and working with knowledge management systems. Several student responses pertaining to this question are as follows:

The instructor was interested in introducing some aspect of groupware to complement the class.

The main objective was to evaluate a knowledge management tool with the possibility of combining a technical element to support the delivery of knowledge within a knowledge management class and to examine if the wiki can be used as a tool to facilitate knowledge management in future classes.

I believe the instructor's goal was to allow the students to explore, test and administer an online collaborative tool and determine whether or not it was a successful knowledge management tool.

The instructor wanted the students to understand knowledge management by creating a knowledge management system. I think the professor saw the wiki as a practical tool for creating a knowledge management system.

These responses suggest that the instructor's objectives for using the system were clear to the participants. However, when students were questioned if it had been clear how the wiki technology was to have been used to support these objectives, there were mixed responses. The following responses illustrate our point.

No, the goals of using the wiki technology were not clearly communicated. The timing of using the wiki technology was not there either in that students lack of prep time. Assuming we had clearly established how the systems would be used to support the class goals, this would have been better.

No, I do not believe the goal was clearly communicated nor was it clearly defined when the professor decided to use the wiki technology.

Core value of the wiki technology was not understood as we spent too much time figuring out how the system should work rather than using it in an effective manner. It was difficult to distinguish between who were the users and creators of the system. This made the use of the technology even more complicated.

Another student highlighted the conflict between the goals of the students and the goals of the instructor. Specifically, this student mentioned that:

Knowledge is a product of collaborative effort and is not an individual product. We should have focused on extending the ideas of others and not working on ours solely. This was not achieved however. The instructor's intentions were clear. We were encouraged to use the wiki technology on a regular basis and not for 1 day of the week. But this did not happen in reality. The idea of mismatch between goals was clear. While we were encouraged to develop a knowledge management system based on collaborative effort, we ended up focusing on our own goals within the system.

The goal was clearly communicated in terms of the why, but the confusion came from the lack of understanding of how we were to implement and use the wiki technology. In addition, we were not clear as to how our contributions collectively were being evaluated. This could have been specified clearly.

The responses above suggest that students had been clear in their understanding of the instructor's objectives for using the wiki. However, the majority had not been clear about how the wiki should be used to support these objectives. In the end this led to confusion and ultimately a lack of sustained enthusiasm amongst the wiki community.

The respondents were also requested to talk about the use of wiki technology within an academic setting in support of knowledge management efforts. On balance, the majority of respondents formed the view that wiki technology is indeed powerful and can assist the overall teaching and learning

process. However, the technology has to be designed before it is introduced in the classroom, to ensure that students are comfortable in using wiki technology features to manage knowledge effectively. The following responses illustrate this point:

Yes, the wiki technology is a powerful tool. The goals that it can support are knowledge creation, sharing, and dissemination. However, you have to keep in mind, that the objective must be clear in the beginning; otherwise, instead of supporting knowledge management efforts, it could be an obstacle towards the process.

The wiki is a very powerful tool. Due to the limited timeframe of the class it might even be too powerful. Therefore the features should probably be limited to the essential ones. In my opinion the wiki can support the following goals:

- Sharing of information/knowledge (papers, presentations)
- Demonstrating that there needs to be a benefit for the user otherwise it isn't used
- Show how information/knowledge needs to be organized to be found and to avoid duplicates

Another student provided an interesting insight on this issue, suggesting that systems should be kept simple. Specifically, this student mentioned:

The technology is a powerful tool. However, there needs to be focus on core features without having the need to build a totally sophisticated system. Focus on simple features to support knowledge creation and sharing such as article repository and use of powerful back links, which the wiki technology is capable of. In addition, there is need to provide motivation in using the wiki not based on time but on actual knowledge contribution. Also balance between quantity and quality of information and knowledge created and shared in the system. Finally, we should have focused on content generation based on the principles of supply and demand in that we should create knowledge based on what is needed. Knowledge is only useful if it is used and not for the sake of being created or shared. The wiki technology can support the goals of managing knowledge but the notion of mismatch between instructor-student objectives should be avoided.

Another student stressed the importance of finalizing the wiki technology design before it is introduced to the class. She mentioned that:

Wiki technology can be used as a collaborative learning technology, but a lot of design needs to be done before bringing it into the classroom. To simply place a tool in front of the students without

knowing how they should or could use it is counterproductive.

The students perceived that the wiki technology is indeed a powerful technology to facilitate knowledge management within an academic setting. However, they felt that the objective of using the system both as a product (what and why) and as a process (how to use the system) needed to be addressed up-front. As one of the respondents mentioned, a system could even become counterproductive if its design is not well understood by the end users. Our findings suggest that wiki technology can support knowledge management efforts in a teaching and learning environment. Nevertheless, the effectiveness of using wiki technology is contingent upon how well the wiki features have been designed prior to its introduction and use by the students.

5. DISCUSSION AND LESSONS LEARNED

This case study was conducted to gain experience from using wiki technology in a classroom setting to support teaching and learning. The intention of implementing the wiki technology in the knowledge management class was to gain a better understanding of how this technology could be used to support teaching and learning in courses such as knowledge management through the process of knowledge discovery. The following paragraphs summarize the key lessons learned from this study, from the perspective of the instructor.

5.1 Planning and Training

Planning and training on how to use a new technology to support the teaching and learning process is required before any new technology is introduced in the classroom. Students should be trained to use features within a particular technology before the technology is used in the teaching and learning process. Use of the technology should be planned well ahead and integrated into the overall course design. This would include issues such as making sure that the students are familiar with the technology introduced (Benbunan-Fich 1999) and have a clear definition of grading policies tied to knowledge contribution in a given system (Hein 1998).

Training on the effective use of the technology would be an ongoing requirement. Students are bound to ask how particular features of a system/technology work. Wiki technology is different from simpler technologies such as e-mail in that the skills required to use the technology may not necessarily be acquired instantaneously. The idea that the instructor had for the class was for the students to discover for themselves what features of the technology can support knowledge discovery.

The version of the wiki technology used in this class can support a variety of functions. Not all of these features can be learned instantaneously or can be used without technical support. The system was not customized to enable students to quickly understand how each feature can be used to support knowledge discovery effectively.

In this context, although a technology can offer features that support collaborative knowledge creation and sharing, some level of planning for how these features should be used, coupled with training on how to use them effectively, might be required before the technology is introduced in a classroom environment. This lesson supports the students' view that while the objectives of using the wiki technology were clear, some training on how to use the features effectively to support the process of knowledge discovery was required.

5.2 Instructor's Familiarity with the Technology

The instructor was not familiar with all features of the wiki technology. This was the first time the instructor had used wiki technology as part of his course delivery. Based on discovery learning, the instructor had decided to allow students to discover for themselves how the technology would support knowledge discovery, using the wiki technology as a tool. He allowed the students to take the lead and made his intentions and ideas explicit in the class syllabus. The idea of using wiki technology based on the principles of discovery learning was feasible, albeit risky at the same time. The case study indicates that the students lacked initiative and the enthusiasm to discover for themselves how best to maximize the value potential of wiki technology.

5.3 The Reality of Discovery Learning

Discovery learning requires that people are motivated to learn in this mode. Garrison and Anderson (2003) provide a useful method in classifying different perspectives to understand the role of technology in the context of learning using electronic mediums. From a philosophical stance, they assert that the goal of using technology in education (within the context of e-learning) is to provide students with the ability to manage information effectively. Based on this perspective, they suggest that the following factors be considered when using technology for academic purposes:

- Create an environment that permits the students/participants not only to learn but also with the ability to learn to learn.
- Focus on critical thinking.
- The desired outcome of the education process becomes the ability for students to construct coherent knowledge structures to support the learning process.
- Shift towards a constructive view of teaching and learning to the process of learning and education in general.

The alternative perspective put forth by Garrison and Anderson (2003) is the transactional view. In this context they assert that individual learners should be able to grasp the meaning of knowledge and improve their understanding of a particular subject.

In this regard, they go on to suggest that the learning experience should play a dual role namely (i) "to construct meaning (reconstruction of experiences) from a personal perspective" and (ii) "to refine and confirm this understanding collaboratively within a community of learners" (p.13).

One could argue that wiki technology that is designed and implemented successfully can fulfill both the objectives and 'dual role' of the education process. Technologies such as online discussion systems and group support systems can be designed to support student-centered, constructivist, or discovery learning (Garrison and Anderson 2003, McKendree et al. 1997; Hein 1998). However, while the technology can support discovery learning, students must be motivated to accept and apply this learning modality. The statistics obtained from the wiki technology pages in this case suggest that, in this class, six students contributed approximately to 75% of knowledge contributed in the system.

Motivation needs to play a vital role to ensure people are willing to learn collaboratively. A grading policy that is implemented effectively might be a vital factor in using technology to support discovery learning. Students must feel motivated and excited continuously to use the technology for knowledge discovery. Hein (1998) suggests that rubrics can be used to enhance the assessment of how students use technology. For example, Hein uses the following checklist for one of her classes that is mediated by an online discussion system:

- "Post a comment to the list. (1 point)
- Post a comment and provide your opinion of the topic under discussion. (2 points)
- Post a comment, provide your opinion and provide examples from your own course-related readings. (3 points)
- Post a comment, provide your opinion and provide examples from your own course-related readings, and provide meaningful basis for further discussion. (4 points)" (p.133)

5.4 Does Size Matter?

The class had twenty students. Over time, the students were not able to keep track of the numerous postings and responses created within the system. As one student commented, it had become difficult to distinguish between the knowledge creators and the users. Wiki technology is based on an open, shared system. Anyone can edit and discuss anything on the system.

When using wiki technology in a classroom environment with a relatively large class size, the system needs to be configured with a tracking mechanism that monitors the contribution level of each participant. Although wiki technology can monitor knowledge contribution in terms of quantity (for example tracking pages updated or created by students), determining the quality of knowledge contributed is somewhat subjective, particularly when the class size is large. One approach to overcome this issue would be to (i) limit the number of features enabled on the system and (ii) focus on system features that can best support discovery learning. In a wiki technology, this could mean focusing on features such as the blog, and discussions generated on the wiki pages.

5.5 Wiki Technology Returns

The instructor continues to use wiki technology in his knowledge management class. The experiences learned from the first study are being incorporated into the present incarnation of the technology. The instructor realized that the original version of the technology had too many features with insufficient focus on specific tools to support discovery learning. Some of the tools in the initial version were much more complicated than what he had hoped. It would take additional effort to learn all these tools within a wiki technology effectively.

In the second round of implementation, the number of features used in the wiki technology has been limited. The grading policy is tied to both the quality and quantity of knowledge generated within the system, as suggested by Hein (1998). We plan to report the findings from the second round wiki technology implementation in the near future.

6. CONCLUSIONS

This study uses the example of wiki technology to understand important issues in designing knowledge management systems within an academic environment. Specifically, a case study was conducted to understand if wikis can be used to implement a knowledge management system for teaching and learning and if this technology is effective to support knowledge creation and sharing in an academic setting. The initial findings suggest that effective implementation and use of a wiki to support knowledge management for effective teaching and learning is contingent upon familiarity of both students and instructors with the technology, level of planning involved prior to system implementation and use in class, class size, and the ability to motivate students to learn from one another based on the principles of discovery learning.

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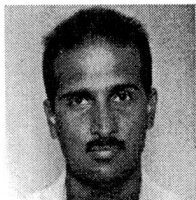
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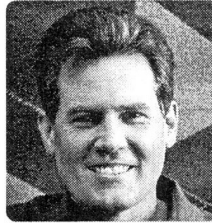
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